

## APPENDIX A SWMU AND AOC REPORTS

This Appendix presents the detailed source characterization reports for the RFI SWMAs, SWMUs and AOCs in the North Field/Main Yard, Central Yard and East Yard. As discussed in Module III of the HSWA permit, the purpose of the 1st-Phase RFI was to conduct confirmatory sampling to identify if releases have occurred from the SWMUs and AOCs. In accordance with the HSWA requirements for a full RFI Investigation as set forth in Module III (Appendix A, Part VI, Task IV, Subpart B and C), these reports summarize the 1st-Phase and Full RFI data for source and contaminant characterization. The additional delineation of LNAPL areas are discussed in Section 7 of the Full RFI Report.

The discussions for each SWMU and AOC include a brief description of the SWMU or AOC, a summary of investigative activities, a brief discussion of the sampling results, a table summarizing specific boring and sampling results and a figure showing the location of each boring/sampling location. Data collected as part of the OWSS investigations and/or adjacent PAOCs are also included as applicable.

More detailed discussions of each SWMU and AOC can be found in the *1st-Phase RFI Soils Report* (January 1997), the *1st-Phase RFI Groundwater Report* (January, 1999) and the *1st-Phase RFI Groundwater Report Addendum No. 1* (December 1999).

### A.1 RFI Soils Characterization Approach

Multiple investigations of the Refinery have provided a large database of analytical results. The database includes analyses from both source materials and potentially affected media. Most of the samples were analyzed for the chemicals on the RCRA Skinner's List, which was designed to provide data on the most prevalent types of waste found at petroleum refineries. Phase I soil samples from potential TEL sites were also analyzed for TEL. In addition, ten percent of the samples collected during the Phase II OWSS Investigation were analyzed for TCL/TAL compounds, which is more extensive than Skinner's List. The first iteration samples were all analyzed for TCL/TAL compounds. Samples from TEL sites were also analyzed for TOL<sup>1</sup>. The second iteration of soil samples collected during the Full RFI were analyzed for a subset of compounds, depending on the specific COCs that were detected above applicable delineation criteria at a given SWMU or AOC.

#### A.1.1 1st-Phase RFI Investigations and 1st- and 2nd-Phase OWSS Investigations

The primary objective of the 1st-Phase RFI was to confirm whether a release had occurred, because many of the SWMUs and AOCs were either identified based on

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<sup>1</sup>TEL and TOL were both analyzed using the California LUFT method; and are essentially the same analysis; however, it is more appropriate to report the analysis as total organic lead; as the method does not speciate for tetraethyl lead.

historical aerial photographs, or, in the case of TEL sites, because they were depicted on the “Proposed TEL Burial Map”. Some of these areas were never actually used for TEL burials or other types of waste management. Therefore, if an action level was exceeded at a given location, it was assumed that a release had occurred. No further sampling was conducted and that area was included in the full RFI. However, if action levels were not exceeded, sampling continued at a given SWMU in accordance with the 1st-Phase sampling strategy, until either a release was identified or sampling confirmed that the area had never been used for TEL burial or other waste management activities. As a result, sampling activity varied among areas.

A screening process was used to identify the chemicals that were detected during historical sampling investigations at frequencies and concentrations that warranted further investigation during the RFI. This screening process included a comparison of historical data to 1st-Phase RFI action levels.

For the 1st-Phase RFI for soils, the action levels for soil were derived by selecting the lowest standard from applicable NJDEP and RCRA Subpart S soil criteria, which included:

- NJDEP NRDCSCC;
- NJDEP IGWSCC; and
- RCRA Subpart S Action Levels.

For the 1st-Phase RFI for groundwater, the action levels for groundwater were derived from NJDEP groundwater criteria for VOCs, SVOCs and metals, and site specific background groundwater concentrations for a limited group of metals that were detected in upgradient background wells. The action levels were selected by choosing the highest of the following concentrations for a given analyte: NJDEP Class IIA GWQC, the NJDEP suggested PQL for the analyte and the actual PQL of the analytical laboratory.

Over 170 soil samples were collected from the three yards during the 1st-Phase Soils Investigation. An additional 90+ samples were collected during the 1st- and 2nd-Phase OWSS Investigations.

During the 1st-Phase Soil and Groundwater Investigations, soil samples and groundwater samples were usually analyzed for Skinner’s List VOCs plus five TICs, Skinner’s List SVOCs plus ten TICs and Skinner’s List metals, unless otherwise noted.

The soil borings were designated according to whether or not a sample was collected from the boring. Borings designated as “SB” or “S” indicate that a soil sample was collected at that location and submitted for laboratory analysis. Soil samples from the other borings were visually characterized and screened for VOCs, but were not analyzed. Samples designated as “HP” or “H” indicate that a groundwater sample was collected from the boring. Borings designated as “TPZ” indicate the location of a temporary piezometer that was installed to monitor for potential LNAPL or to determine the direction of localized groundwater flow.

Groundwater samples were designated according to the sampling method. Groundwater samples designated as "HP" were collected using NJDEP's Alternate Groundwater Sampling Technique 4.0, Passively Placed Narrow Diameter Point (temporary well point). Elevated concentrations of metals have been consistently obtained from these temporary well points. Chevron believes that the elevated metals concentrations in the groundwater samples from the temporary well points are likely attributable to the turbidity of the sample, and are not representative of natural groundwater characteristics.

Groundwater samples designated as "H" were collected for metals analysis using the Porous Media presented in Chevron's Porous Media Pilot Study (dated July 20, 1998). Although Chevron believes that the groundwater samples collected through the porous media are more representative of natural groundwater conditions for metals, a detailed comparison of groundwater samples collected using low-flow sampling techniques to groundwater samples collected using porous media indicate that the porous media results for metals are elevated compared to the monitoring well data. In addition, the occurrence of elevated SVOCs in hydropunch samples has not been confirmed in groundwater samples from nearby monitoring wells.

In some cases where two borings were located in close proximity to each other, such as a soil sampling location and a groundwater sampling location, an additional log was not obtained for the second boring, and the lithology was assumed to be consistent. However, PID readings and water level readings were usually obtained from the second boring.

The primary objective of the 1st-Phase RFI was to confirm whether a release had occurred, because many of the SWMUs and AOCs were either identified based on historical aerial photographs or, in the case of TEL sites, because they were depicted on the "Proposed TEL Burial Map". Some of these areas were never actually used for TEL burials or other types of waste management. Therefore, as soon as an action level was exceeded at a given location, it was assumed that a release had occurred, and no further sampling was conducted because that area would be included in the Full RFI. However, if action levels were not exceeded, sampling continued at a given SWMU in accordance with the 1st-Phase sampling strategy, until either a release was identified or sampling confirmed that the area had never been used for TEL burial or other waste management activities. As a result, some areas had very little sampling activity, and other areas were extensively sampled during the 1st-Phase Investigations.

The sampling strategy during the 2nd-Phase OWSS was modified to target groundwater. One groundwater sample was collected at each of the proposed sampling points, and soil samples were to be collected from the vadose zone if evidence of environmental impacts were observed. Groundwater samples were obtained from the first water bearing zone using NJDEP's Alternate Groundwater Sampling Technique 4.0. Samples collected for VOC or SVOC analyses were collected using a bailer after slotted PVC was driven to depth. "Porous media" and a peristaltic pump were used to collect samples to be analyzed for metals.

### A.1.2 Full RFI Soils Investigation

The proposed sampling strategy during the Full RFI for each SWMA, SWMU and AOC was an iterative process designed to provide additional data for the following purposes:

- Further define the lateral and vertical extent of the source material;
- Characterization of the source material; and
- Provide adequate data for risk characterization.

The number of samples collected at each SWMU and AOC during the Full RFI was dependent on the number of samples that had been previously collected as well as gaps in delineation per the RFI Workplan. In most cases, one or two additional borings were sufficient to better define the lateral extent of the source material. This was often the case at SWMUs where one of the outermost samples had a delineation criteria exceedance.

At each sampling location, continuous borings were completed to the water table or until native material was encountered, in order to further delineate the vertical extent of the source material. A portion of the soil sample from every two-foot depth interval was screened for volatile organic vapors. Samples for VOC analysis were collected as soon as the split spoon sample was opened to prevent potential loss of VOCs. During the first iteration, three samples from each boring were sent for laboratory analyses as follows:

- A surficial soil sample was collected from approximately zero to two feet bgs or immediately below pavement. Samples for VOC analysis were collected in accordance with TRSR requirements, as defined in 7:26E-3.6(1)4.
- A second sample was selected based on headspace screening as well as visual observations. The sample that exhibited the highest headspace reading and/or the most signs of contamination was selected for analysis. If none of the sampling intervals showed evidence of visual contamination or elevated headspace readings, the soil sample from the interval just above the water table was selected for analysis.
- A third sample was collected in the native material one to two feet below the fill layer (e.g., peat, clay or outwash), provided that there was no visual evidence of contamination or elevated headspace readings. If there was evidence of contamination in the uppermost portion of the native material, then the sample was collected from the interval approximately one to two feet below the last evidence of contamination.

All samples collected during the first iteration of the Full RFI were analyzed for TCL volatiles and semi-volatiles and TAL metals, unless otherwise noted. TICs with CAS numbers were also reported and evaluated as part of the RFI.

Samples from TEL sites were also analyzed for TOL to confirm the findings of the 1st-Phase sampling results. Both 1st-Phase and Full RFI soil samples collected for TEL

analyses were analyzed by the State of California LUFT methodology (1989). The LUFT method was and continues to be a widely accepted method to analyze for total alkyl-lead, and will be used to analyze for TEL.

A second iteration of sampling was conducted after the results from the first round of sampling were evaluated. The need for and placement of additional samples for delineation of SWMUs and AOCs were based on the initial samples that had been proposed in the RFI Workplan, coupled with previous analytical data in order to delineate and characterize potential source areas. These data and additional proposed sampling locations were presented and discussed with the Agencies during three meetings that occurred during the Autumn of 2002. Additional samples were collected and analyzed for a subset of the TCL/TAL list, depending on what COCs required additional delineation.

### **A.1.3 Full RFI Delineation Criteria**

Soil and groundwater delineation criteria were used to screen both the Full RFI data and previous relevant data so that the need for further evaluation and delineation could be determined. In the RFI Workplan, Chevron proposed a hierarchy for selecting soil and groundwater delineation criteria. Table A.1.1 lists the delineation criteria for soils. In general, NJDEP criteria are specified, with the following exceptions:

- Figure A.1.1 provides a generic flow chart for identification of soil delineation criteria, that includes the situation where NJDEP does not have criteria for a detected constituent but an EPA resource has identified a criterion for soil;
- In cases where the delineation criteria is lower than analytical limits (such as TOL), the delineation level was based on the laboratory's reporting limit. In EPA's letter to Robert E. Mancini dated November 18, 2002, EPA and NJDEP agreed that the delineation criteria for TOL could be based on the LOQ of 2 mg/kg.
- In addition, in Chevron's letter to Anthony Cinque dated February 12, 2003, Chevron requested approval by NJDEP for use of criteria different from those available from NJDEP for beryllium, chrysene, thallium and zinc in soil and ammonia in groundwater. The ARC for direct contact only, approved by NJDEP and EPA for this site in EPA's letter dated August 22, 2003 are: beryllium (RDCSCC 16 mg/kg, NRDCSCC 200 mg/kg), thallium (RDCSCC 5.5 mg/kg, NRDCSCC 72 mg/kg), and chrysene (RDCSCC 62 mg/kg, NRDCSCC 230 mg/kg). The requested ARC for zinc was not approved by NJDEP, and the alternate groundwater standard for ammonia is pending because groundwater ARCs are obtained through the BGWPA.

In addition to listing the most conservative delineation criteria, applicable screening levels for unsaturated soils, saturated soils, on-site soils and soils at the property boundary are listed on Table A.1.1, unless the most conservative delineation criteria is applicable to all cases. For example, certain compounds may be less mobile and therefore less likely to migrate from soil to water. In this case, the direct contact

**Table A.1.1. Full RFI Soil and Groundwater Delineation Criteria**

CAS #	Compound Name	Site Specific Groundwater (µg/L)	Soil				
			Most Conservative (mg/kg)	Unsaturated PB (mg/kg)	Saturated PB (mg/kg)	Unsaturated On-Site (mg/kg)	Saturated On-Site (mg/kg)
7429-90-5	Aluminum	200	76,000	76,000	76,000	100,000	100,000
7440-36-0	Antimony	20	14	14	14	340	340
7440-38-2	Arsenic	8	20	20	20	20	20
7440-39-3	Barium	2,000	700	700	700	47,000	47,000
7440-41-7	Beryllium	20	16	16	16	200	200
7440-43-9	Cadmium	4	39	39	39	100	100
7440-70-2	Calcium						
7440-47-3	Chromium	100	120,000	120,000	120,000	120,000	120,000
18540-29-9	Chromium (hexavalent)	110	240	240	240	6,100	6,100
7440-48-4	Cobalt	100	900	900	900	1,900	1,900
7440-50-8	Copper	1,000	600	600	600	600	600
57-12-5	Cyanide	200	1,100	1,100	1,100	21,000	21,000
7439-89-6	Iron	300	23,000	23,000	23,000	100,000	100,000
7439-92-1	Lead	10	400	400	400	600	600
7439-95-4	Magnesium						
7439-96-5	Manganese	50	1,800	1,800	1,800	19,000	19,000
7439-97-6	Mercury	2	14	14	14	270	270
7440-02-0	Nickel	100	250	250	250	2,400	2,400
7440-09-07	Potassium						
7782-49-2	Selenium	50	63	63	63	3,100	3,100
7440-22-4	Silver	30	110	110	110	4,100	4,100
7440-23-5	Sodium	50,000					
7440-28-0	Thallium	10	6	6	6	72	72
78-00-2	Tetraethyl Lead		2	2	2	2	2
N/A	Total Organic Lead		2	2	2	2	2
7440-03-15	Tin		47,000	47,000	47,000	100,000	100,000
7440-62-2	Vanadium	2,600	370	370	370	7,100	7,100
7440-66-6	Zinc	5,000	1,500	1,500	1,500	1,500	1,500
71-43-2	Benzene	1	1	1	3	1	13
100-41-4	Ethylbenzene	700	100	100	1,000	100	1,000
108-88-3	Toluene	1,000	500	500	1,000	500	1,000
1330-20-7	Xylene	1,000	67	67	410	67	1,000
83-32-9	Acenaphthene	400	100	100	3,400	100	10,000

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CAS #	Compound Name	Site Specific Groundwater (µg/L)	Soil				
			Most Conservative (mg/kg)	Unsaturated PB (mg/kg)	Saturated PB (mg/kg)	Unsaturated On-Site (mg/kg)	Saturated On-Site (mg/kg)
208-96-8	Acenaphthylene	100	10,000	10,000	10,000	10,000	10,000
120-12-7	Anthracene	2,000	100	100	10,000	100	10,000
56-55-3	Benzo(a)anthracene	0.2	0.9	1	1	4	4
50-32-8	Benzo(a)pyrene	0.2	0.66	1	1	1	1
205-99-2	Benzo(b)fluoranthene	10	0.9	1	1	4	4
191-24-2	Benzo(g,h,i)perylene	100	10000	10,000	10,000	10,000	10,000
207-08-9	Benzo(k)fluoranthene	1	0.9	1	1	4	4
218-01-9	Chrysene	5	62	62	62	230	230
53-70-3	Dibenzo(a,h)anthracene	0.5	0.66	1	1	1	1
206-44-0	Fluoranthene	300	100	100	2,300	100	10,000
86-73-7	Fluorene	300	100	100	2,300	100	10,000
193-39-5	Indeno(1,2,3-cd)pyrene	10	0.9	1	1	4	4
91-20-3	Naphthalene	300	100	100	230	100	4,200
90-12-0	1-Methyl naphthalene	100	10,000	10,000	10,000	10,000	10,000
91-57-6	2-Methyl naphthalene	100	10,000	10,000	10,000	10,000	10,000
85-01-8	Phenanthrene	100	10,000	10,000	10,000	10,000	10,000
129-00-0	Pyrene	200	100	100	1,700	100	10,000
64-19-7	Acetic acid		10,000	10,000	10,000	10,000	10,000
67-64-1	Acetone	700	100	100	1,000	100	1,000
98-86-2	Acetophenone	1000	0.00022	0.00022	1000	0.00022	1000
107-02-8	Acrolein		0.1	0.1	0.1	0.34	0.34
107-13-1	Acrylonitrile			1	1	1	5
309-00-2	Aldrin		0.04	0.04	0.04	0.17	0.17
N/A	Alkalinity (as CaCO <sub>3</sub> )						
N/A	Alkalinity to pH 4.5						
319-84-6	alpha-BHC (alpha HCH)	0.02	0.005	0.005	0.1	0.005	0.5
5103-71-9	alpha-Chlordane	5	10,000	10,000	10,000	10,000	10,000
7664-41-7	Ammonia	3,000	10,000	10,000	10,000	10,000	10,000
62-53-3	Aniline	6	85	85	85	300	300
84-65-1	9,10-Anthraquinone	100	10,000	10,000	10,000	10,000	10,000
53469-21-9	Aroclor 1242		0.22	0.22	0.74		
12672-29-6	Aroclor 1248		0.22	0.22	0.74		
11097-69-1	Aroclor 1254		0.22	0.22	0.74		

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			Most Conservative (mg/kg)	Unsaturated PB (mg/kg)	Saturated PB (mg/kg)	Unsaturated On-Site (mg/kg)	Saturated On-Site (mg/kg)
11096-82-5	Aroclor 1260		0.22	0.22	0.74		
1912-24-9	Atrazine	3	2.2	2.2	2.2	7.8	7.8
100-52-7	Benzaldehyde	100	6,100	6,100	6,100	10,000	10,000
N/A	Benzen-d5-amine	100	10,000	10,000	10,000	10,000	10,000
108-98-5	Benzenethiol (thiophenol)	100	1	1	1	20	20
65-85-0	Benzoic acid	30,000	10,000	10,000	10,000	10,000	10,000
319-85-7	beta-BHC (beta-HCH)	0.2	0.4	0.4	0.4	2	2
N/A	Bicarbonate (as CaCO <sub>3</sub> )						
92-52-4	Biphenyl (1,1-biphenyl)	400	350	350	350	350	350
111-91-1	Bis(2-chloroethoxy)methane	100	10,000	10,000	10,000	10,000	10,000
111-44-4	Bis(2-chloroethyl)ether	10	0.66	0.66	0.66	3	3
117-81-7	Bis(2-ethylhexyl)phthalate	30	49	49	49	100	210
80-05-7	Bisphenol A	100	3,100	3,100	3,100	10,000	10,000
314-40-9	Bromacil (pesticide)	5	10,000	10,000	10,000	10,000	10,000
108-86-1	Bromobenzene		28	28	28	92	92
75-27-4	Bromodichloromethane (Dichlorobromomethane)	1	1	1	11	1	46
460-00-4	4-Bromofluorobenzene		1,000	1,000	1,000	1,000	1,000
75-25-2	Bromoform	4	1	1	86	1	370
74-83-9	Bromomethane	10	1	1	79	1	1,000
101-55-3	4-Bromophenyl-phenylether	100	1,000	1,000	1,000	1,000	1,000
106-97-3	Butane	100	1,000	1,000	1,000	1,000	1,000
99-40-58	2-methoxy-2-methylbutane	100	1,000	1,000	1,000	1,000	1,000
85-68-7	Butyl benzyl phthalate	100	100	100	1,100	100	10,000
123-05-5	Butyl stearate			10,000	10,000	10,000	10,000
104-51-8	n-Butylbenzene-	100	240	240	240	240	240
135-98-8	sec-Butylbenzene	100	220	220	220	220	220
98-06-6	tert-Butylbenzene	100	390	390	390	390	390
N/A	C11-C14		10,000	10,000	10,000	10,000	10,000
N/A	C15-C28		10,000	10,000	10,000	10,000	10,000
N/A	C29-C40		10,000	10,000	10,000	10,000	10,000
N/A	C6-C10	100	10,000	10,000	10,000	10,000	10,000
N/A	<C6		10,000	10,000	10,000	10,000	10,000

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CAS #	Compound Name	Site Specific Groundwater (µg/L)	Soil				
			Most Conservative (mg/kg)	Unsaturated PB (mg/kg)	Saturated PB (mg/kg)	Unsaturated On-Site (mg/kg)	Saturated On-Site (mg/kg)
105-60-2	Caprolactam	100	10,000	10,000	10,000	10,000	10,000
86-74-8	Carbazole	5	0.6	0.6	24	0.6	96
624-64-6	Carbon Dioxide						
75-15-0	Carbon disulfide	800	32	32	1,000	32	1,000
N/A	Carbonate (as CaCO <sub>3</sub> )						
56-23-5	Carbon tetrachloride	2	1	1	2	1	4
5103-74-2	Chlordane, gamma			10,000	10,000	10,000	10,000
16887-00-6	Chloride	250,000					
106-47-8	4-Chloroaniline (p-chloroaniline)	30	230	230	230	4,200	4,200
108-90-7	Chlorobenzene	4	1	1	37	1	680
74-97-5	Chlorobromomethane		10,000	10,000	10,000	10,000	10,000
75-00-3	Chloroethane	100	3	3	3	7	7
67-66-3	Chloroform	6	1	1	19	1	28
593-71-5	Chloriodomethane	100	1,000	1,000	1,000	1,000	1,000
59-50-7	p-Chloro-m-cresol (4-chloro-3-methyl phenol)	100	100	100	10,000	100	10,000
75-87-3	Chloromethane (methyl chloride)	30	10	10	520	10	1,000
91-58-7	2-Chloronaphthalene	600	1,000	1,000	1,000	1,000	1,000
95-57-8	2-Chlorophenol (o-chlorophenol)	40	10	10	280	10	5,200
7005-72-3	4-Chlorophenyl-phenylether	100	1,000	1,000	1,000	1,000	1,000
39638-32-9 (108-60-1)	1-(2,2-Oxybis)chloropropane, (2-chloroisopropylether)	100	10	10	2,300	10	10,000
94-49-8	2-Chlorotoluene (o-chlorotoluene)		160	160	160	560	560
106-43-4	4-Chlorotoluene (p-chlorotoluene)		1,000	1,000	1,000	1,000	1,000
108-39-4	m-Cresol (3-methylphenol)	100	3,100	3,100	3,100	10,000	10,000
106-44-5	p-Cresol (4-methylphenol)	100	2,800	2,800	2,800	10,000	10,000
98-82-8	Cumene (Isopropylbenzene; 1-methylethyl-benzene)	800	570	570	570	1,000	1,000
110-82-7	Cyclohexane	100	140	140	140	140	140
3073-66-3	1,1,3-trimethylcyclohexane	100	1,000	1,000	1,000	1,000	1,000
N/A	2-Butyl-1,1,3-t-cyclohexane	100	1,000	1,000	1,000	1,000	1,000
1678-93-9	Butylcyclohexane	100	1,000	1,000	1,000	1,000	1,000
1678-92-8	Propylcyclohexane	100	1,000	1,000	1,000	1,000	1,000

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CAS #	Compound Name	Site Specific Groundwater (µg/L)	Soil				
			Most Conservative (mg/kg)	Unsaturated PB (mg/kg)	Saturated PB (mg/kg)	Unsaturated On-Site (mg/kg)	Saturated On-Site (mg/kg)
3788-32-7	2-Methylpropylcyclopentane	100	1,000	1,000	1,000	1,000	1,000
99-87-6	p-Cymene	100	1,000	1,000	1,000	1,000	1,000
72-54-8	4,4'-DDD	0.1	3	3	3	12	12
72-55-9	4,4'-DDE		2	2	2	9	9
50-29-3	4,4'-DDT	0.1	2	2	2	9	9
319-86-8	delta-BHC (delta HCH)	100	10,000	10,000	10,000	10,000	10,000
132-64-9	Dibenzofuran	100	290	290	290	1,000	1,000
132-65-0	Dibenzothiophene	100	10,000	10,000	10,000	10,000	10,000
96-12-8	1,2-Dibromo-3-chloropropane	1	0.45	0.45	0.45	2	2
124-48-1	Dibromochloromethane	10	1	1	110	1	1,000
541-73-1	m-Dichlorobenzene (1,3-dichlorobenzene)	600	100	100	5,100	100	10,000
95-50-1	o-Dichlorobenzene (1,2-dichlorobenzene)	600	50	50	5,100	50	10,000
106-46-7	p-Dichlorobenzene (1,4-Dichlorobenzene)	75	100	100	570	100	10,000
91-94-1	3,3-Dichlorobenzidine	60	2	2	2	6	6
75-71-8	Dichlorodifluoromethane (Freon 12)	1,000	94	94	94	310	310
75-34-3	1,1-Dichloroethane	70	10	10	570	10	1,000
107-06-2	1,2-Dichloroethane	2	1	1	6	1	24
540-59-0	1,2-Dichloroethene	10	1	1	79	1	1,000
156-60-5	trans-1,2-Dichloroethene	100	50	50	1,000	50	1,000
75-35-4	1,1-Dichloroethylene	2	8	8	8	10	150
156-59-2	cis-1,2-Dichloroethylene	10	1	1	79	1	1,000
75-09-2	Dichloromethane (methylene chloride)	2	1	1	49	1	210
120-83-2	2,4-Dichlorophenol	20	10	10	170	10	3,100
78-87-5	1,2-Dichloropropane	1	10	10	10	43	43
142-28-9	1,3-Dichloropropane		1,000	1,000	1,000	1,000	1,000
563-58-6	1,1-Dichloropropene		1,000	1,000	1,000	1,000	1,000
594-20-7	sec-Dichloropropane		1,000	1,000	1,000	1,000	1,000
10061-01-5	sis-1,3-Dichloropropene	5	1	1	4	1	5
10061-02-6	trans-1,3-Dichloropropene	5	1	1	4	1	5
60-57-1	Dieldrin	0.03	0.042	0	0	0	0
84-66-2	Diethyl phthalate	5,000	50	50	10,000	50	10,000
57-97-6	7,12-Dimethylbenz(a)anthracene	100	10,000	10,000	10,000	10,000	10,000
95-47-6	1,2-Dimethyl-benzene (o-Xylene)	100	1,000	1,000	1,000	1,000	1,000

**Table A.1.1. Full RFI Soil and Groundwater Delineation Criteria**

CAS #	Compound Name	Site Specific Groundwater (µg/L)	Soil				
			Most Conservative (mg/kg)	Unsaturated PB (mg/kg)	Saturated PB (mg/kg)	Unsaturated On-Site (mg/kg)	Saturated On-Site (mg/kg)
590-50-1	4,4-Dimethyl-2-pentanone	100	10,000	10,000	10,000	10,000	10,000
1207-15-4	2,8-Dimethylbenzo(b,d)thio	100	1,000	1,000	1,000	1,000	1,000
105-67-9	2,4-Dimethylphenol	100	10	10	1,100	10	10,000
576-26-1	2,6-Dimethylphenol	100	38	38	38	380	380
108-68-9	3,5-Dimethylphenol	100	10,000	10,000	10,000	10,000	10,000
131-11-3	Dimethylphthalate	100	50	50	10,000	50	10,000
84-74-2	Di-n-butyl phthalate	900	100	100	5,700	100	10,000
534-52-1	4,6-Dinitro-2-methylphenol	100	7.8	7.8	7.8	100	100
51-28-5	2,4-Dinitrophenol	40	10	10	110	10	2,100
121-14-2	2,4-Dinitrotoluene	10	1	1	1	4	4
606-20-2	2,6-Dinitrotoluene	5	1	1	1	4	4
117-84-0	Di-n-octyl phthalate	100	100	100	1,100	100	10,000
959-98-8	Endosulfan I	0.4	50	50	340	50	6,200
33213-65-9	Endosulfan II	0.4	50	50	340	50	6,200
1031-07-8	Endosulfan sulfate	0.4	50	50	340	50	6,200
72-20-8	Endrin	2	17	17	17	50	310
104-76-7	2-Ethyl-1-hexanol	100	1000	1,000	1,000	1,000	1,000
1678-91-7	Ethylcyclohexane	100	1000	1,000	1,000	1,000	1,000
106-93-4	Ethylene dibromide (EDB; 1,2-dibromoethane)	0.05	0.0069	0	0	0	0
15438-31-0	Ferrous Iron						
68476-33-5	Fuel oil no. 6		10,000	10,000	10,000	10,000	10,000
8006-61-9	Gasoline	100	10,000	10,000	10,000	10,000	10,000
N	Hardness	250,000					
76-44-8	Heptachlor	0.4	0.15	0.15	0.15	0.65	0.65
1024-57-3	Heptachlor epoxide	0.2	0.07	0.07	0.07	0.3	0.3
592-27-8	2-Methylheptane	100	10,000	10,000	10,000	10,000	10,000
118-74-1	Hexachlorobenzene	10	0.66	0.66	0.66	2	2
87-68-3	Hexachlorobutadiene	1	1	1	1	21	21
77-47-4	Hexachlorocyclopentadiene	50	100	100	400	100	7300
67-72-1	Hexachloroethane	10	6	6	6	100	100
110-54-3	Hexane (n-Hexane)	30	110	110	110	110	110
591-78-6	2-Hexanone	100	3,100	3,100	3,100	10,000	10,000

**Table A.1.1. Full RFI Soil and Groundwater Delineation Criteria**

CAS #	Compound Name	Site Specific Groundwater (µg/L)	Soil				
			Most Conservative (mg/kg)	Unsaturated PB (mg/kg)	Saturated PB (mg/kg)	Unsaturated On-Site (mg/kg)	Saturated On-Site (mg/kg)
123-42-2	2-Hydroxy-2-methyl-4-pentanone	100	1,000	1,000	1,000	1,000	1,000
95-13-6	Indene	100	10,000	10,000	10,000	10,000	10,000
54832-83-6	1H-Indene		10,000	10,000	10,000	10,000	10,000
85-44-9	1,3-Isobenzofurandione	100	1,000	1,000	1,000	1,000	1,000
78-78-4	Isopentane	100	10,000	10,000	10,000	10,000	10,000
78-59-1	Isophorone	100	50	50	1,100	50	10,000
98-82-8	Isopropylbenzene (cumene; 1-methylethyl-benzene)	800	570	570	570	1,000	1,000
5989-27-5	Limonene (d-Limonene)	100	10,000	10,000	10,000	10,000	10,000
58-89-9	Lindane (gamma BHC; gamma HCH)	0.2	0.52	1	1	2	2
149-30-4	2-Mercaptobenzothiozole	5	17	17	17	59	59
126-98-7	Methacrylonitrile	100	2.1	2	2	8	8
74-82-8	Methane	100	1,000	1,000	1,000	1,000	1,000
79-20-9	Methyl acetate	7,000	1,000	1,000	1,000	1,000	1,000
1705-85-57	6-Methyl chrysene	100	10,000	10,000	10,000	10,000	10,000
98-82-8	1-Methylethyl-benzene (Isopropylbenzene, cumene)	800	570	570	570	1,000	1,000
78-93-3	Methyl ethyl ketone (2-Butanone)	300	50	50	1,000	50	1,000
108-10-1	4-Methyl-2-pentanone (methyl isobutyl ketone; MIBK)	400	50	50	1,000	50	1,000
141-79-7	4-Methyl-3-penten-2-one	100	10,000	10,000	10,000	10,000	10,000
108-87-2	Methylcyclohexane	100	1,000	1,000	1,000	1,000	1,000
590-67-0	1-Methylcyclohexanol	100	1,000	1,000	1,000	1,000	1,000
96-37-7	Methylcyclopentane	100	10,000	1,000	1,000	1,000	1,000
75-95-3	Methylene bromide		67	67	67	230	230
75-09-2	Methylene chloride (dichloromethane)	2	1	1	49	1	210
589-81-1	3-Methylheptane	100	1,000	1,000	1,000	1,000	1,000
591-76-4	2-Methylhexane	100	1,000	1,000	1,000	1,000	1,000
589-34-4	3-Methylhexane	100	1,000	1,000	1,000	1,000	1,000
107-83-5	2-Methylpentane	100	1,000	1,000	1,000	1,000	1,000
96-14-0	3-Methylpentane	100	1,000	1,000	1,000	1,000	1,000
95-48-7	2-Methylphenol (o-cresol)	100	2,800	2,800	2,800	10,000	10,000
108-39-4	3-Methylphenol (m-cresol)	100	3,100	3,100	3,100	10,000	10,000
106-44-5	4-Methylphenol (p-cresol)	100	2,800	2,800	2,800	10,000	10,000

**Table A.1.1. Full RFI Soil and Groundwater Delineation Criteria**

CAS #	Compound Name	Site Specific Groundwater (µg/L)	Soil				
			Most Conservative (mg/kg)	Unsaturated PB (mg/kg)	Saturated PB (mg/kg)	Unsaturated On-Site (mg/kg)	Saturated On-Site (mg/kg)
1634-04-4	MTBE	70	62	62	62	160	160
2958-76-1	Decahydro-2-methylnaphthalene	100	10,000	10,000	10,000	10,000	10,000
14797-55-8	Nitrate	10,000					
14797-65-0	Nitrite (as N)	1,000					
88-4-4	2-Nitroaniline	100	1.7	1.7	1.7	18	18
99-09-2	3-Nitroaniline	100	23	23	23	140	140
100-01-6	4-Nitroaniline	100	32	32	32	140	140
98-95-3	Nitrobenzene	10	10	10	28	10	520
88-75-5	2-Nitrophenol	100	10,000	10,000	10,000	10,000	10,000
100-02-7	4-Nitrophenol	100	1.7	1.7	630	1.7	10,000
86-30-6	N-Nitroso-di-n-propylamine	20	0.66	0.66	0.66	0.66	0.66
86-30-6	N-Nitrosodiphenylamine	20	100	100	140	100	600
17301-94-9	4-Methylnonane	100	10,000	1,000	1,000	1,000	1,000
95-13-6?	2,2,4,4-1H-Indene-octahydro	100	10,000	10,000	10,000	10,000	10,000
2216-34-4	4-Methyloctane	100	10,000	1,000	1,000	1,000	1,000
14265-44-2	Orthophosphate						
1336-36-3	PCBs	0.5	0.49	0.49	0.49	2	2
87-86-5	Pentachlorophenol	1	6	6	6	24	24
565-75-3	2,3,4-Trimethylpentane	100	10,000	1,000	1,000	1,000	1,000
109-66-0	n-Pentane-	100	10,000	1,000	1,000	1,000	1,000
77-74-7	3-Methyl-3-pentanol	100	1,000	1,000	1,000	1,000	1,000
565-69-5	2-methyl-3-pentanone	100	1,000	1,000	1,000	1,000	1,000
198-55-0	Perylene		10,000	10,000	10,000	10,000	10,000
832-69-9	1-methylphenanthrene	100	10,000	10,000	10,000	10,000	10,000
N/A	2,7-Dimethylphenanthrene	100	10,000	10,000	10,000	10,000	10,000
108-95-2	Phenol	4,000	50	50	10,000	50	10,000
6180-61-6	1-propanol-3-phenoxy	100	1,000	1,000	1,000	1,000	1,000
103-82-2	Phenylacetic acid	100	10,000	10,000	10,000	10,000	10,000
612-94-2	2-Phenylnaphthalene	100	10,000	10,000	10,000	10,000	10,000
7723-14-0	Phosphorus	0.73					
103-65-1	n-Propylbenzene	100	240	240	240	240	240
91-22-5	Quinoline	5	0.16	0	0	1	1
111-02-4	Squalene	100	10,000	10,000	10,000	10,000	10,000

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			Most Conservative (mg/kg)	Unsaturated PB (mg/kg)	Saturated PB (mg/kg)	Unsaturated On-Site (mg/kg)	Saturated On-Site (mg/kg)
100-42-5	Styrene	100	23	23	23	97	97
14808-79-8	Sulfate	250,000					
N/A	Sulfide Reactivity						
N/A	TDS	500,000					
75-65-0	Tert-butyl alcohol (TBA; 2-methyl- 2-propanol)	100	1,000	1,000	1,000	1,000	1,000
79-34-5	1,1,2,2-Tetrachloroethane	2	1	1	34	1	70
630-20-6	1,1,1,2-Tetrachloroethane		1	1	170	1	310
127-18-4	Tetrachloroethylene	1	1	1	4	1	6
110-01-0	Thiophene, tetrahydro	100	10,000	10,000	10,000	10,000	10,000
1600-44-8	1-Oxy-tetrahydrothiophene	100	10,000	10,000	10,000	10,000	10,000
4740-00-5	Tetrahydro-3-methylthiophene	100	10,000	10,000	10,000	10,000	10,000
N/A	TOC						
N/A	TPH		1,000	1,000	1,000	1,000	1,000
87-61-6	1,2,3-Trichlorobenzene		1,000	1,000	1,000	1,000	1,000
120-82-1	1,2,4-Trichlorobenzene	9	68	68	68	100	1,200
71-55-6	1,1,1-Trichloroethane	30	50	50	210	50	1,000
79-00-5	1,1,2-Trichloroethane	3	1	1	22	1	420
79-01-6	Trichloroethylene	1	1	1	23	1	54
96-18-4	1,2,3-Trichloropropane		0.005	0.005	0.005	0.011	0.011
95-95-4	2,4,5-Trichlorophenol	700	50	50	5,600	50	10,000
88-06-2	2,4,6-Trichlorophenol	20	10	10	62	10	270
75-69-4	Trichlorofluoromethane (Freon 11)	2,000	390	390	390	1,000	1,000
76-13-1	Trichlorotrifluoroethane (Freon 113)	100	1,000	1,000	1,000	1,000	1,000
95-63-6	1,2,4-Trimethyl benzene	100	52	52	52	170	170
526-73-8	1,2,3-Trimethylbenzene	100	1,000	1,000	1,000	1,000	1,000
108-67-8	1,3,5-Trimethyl-benzene	100	21	21	21	70	70
75-01-4	Vinyl chloride	5	2	2	2	7	7
68476-30-2	No. 2 Fuel Oil	100	10,000	10,000	10,000	10,000	10,000

PB = Property boundary

delineation criteria would be more conservative than the impact to groundwater delineation criteria, so the direct contact delineation criteria would be used for both unsaturated and saturated soils. Likewise, residential criteria are more applicable to impacted soils along the property, while the industrial criteria will be used to delineate soils within the Refinery. The individual summary tables presented in this Appendix list any constituent that exceeds the most conservative applicable delineation criteria, regardless of whether that criterion is applicable. For example, the most conservative delineation criterion for benzene is the impact to groundwater criteria (1 mg/kg), while the residential direct contact delineation criterion for benzene is 3 mg/kg. Therefore, if benzene was detected at a concentration of 2 mg/kg in a saturated soil sample, it would be included on the summary table (in italics) even though the impact to groundwater criterion would no longer be applicable.